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(19) **United States**(12) **Patent Application Publication****Busse et al.**(10) **Pub. No.: US 2002/0071523 A1**(43) **Pub. Date: Jun. 13, 2002**(54) **X-RAY DETECTOR PROVIDED WITH  
INTEGRATED COOLING**

(57)

**ABSTRACT**(76) Inventors: **Falko Busse**, Aachen (DE); **Heinz Van  
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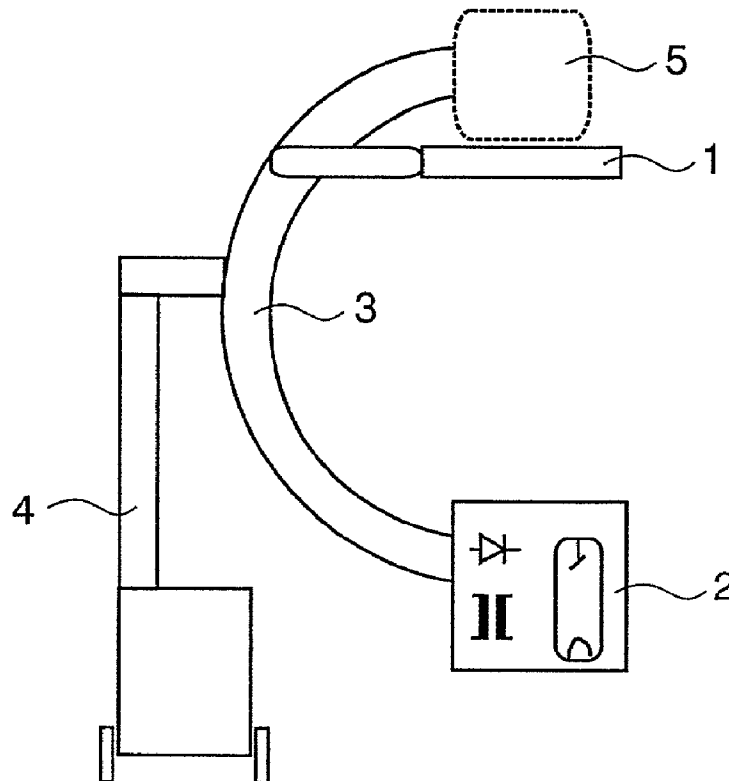
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The invention relates to an X-ray examination apparatus in which the X-ray detector **1** and the X-ray source **2** are subject to keeping the temperature constant and to cooling by way of a common cooling circuit. To this end, a cooling medium of constant temperature is applied to the X-ray detector **1** in order to make the X-ray detector **1** operate at uniform ambient temperatures. The temperature of the cooling medium, thus increased a first time, still suffices to perform cooling of the X-ray source **2**. Consequently, the heated cooling medium, after application to the X-ray detector **1**, is applied to the X-ray source **2** where a second exchange of heat takes place, so that at the same time the X-ray source **2** is cooled without utilizing an additional cooling circuit. This offers the advantage that relevant X-ray examination apparatus may have a simple construction, that the electronic components used in the construction have a correspondingly prolonged service life due to the constant low temperature, and that the apparatus can operate with a higher mean power as a result of the cooling.



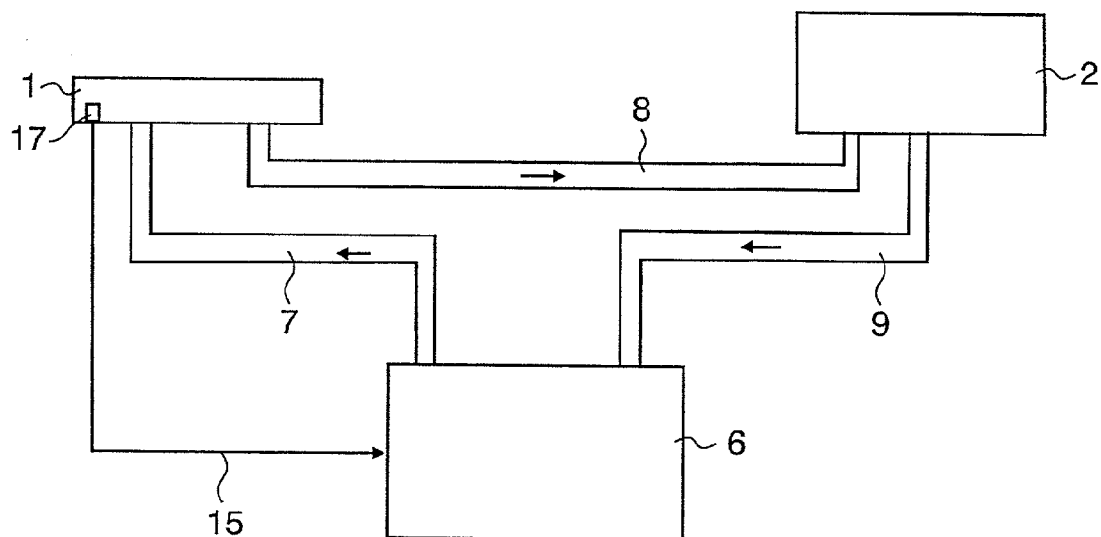


Fig.2

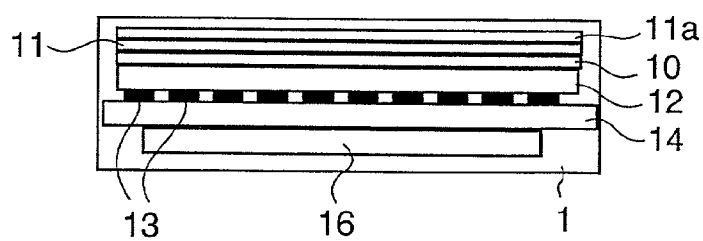


Fig.3

a constant temperature of 20° C. is fed, via a first sub-system 7 of the duct system, to the X-ray detector 1. Therein, a first exchange of heat takes place between the X-ray detector 1 and the cooling medium. The cooling medium, now having a temperature of 25° C., is applied to the X-ray source 2 via a second duct sub-system 8. The X-ray source produces temperatures in excess of 50° C. The supply of the cooling medium to the X-ray source enables a second exchange of heat which reduces the temperature of the X-ray source to a maximum of 50° C. The second exchange of heat heats the cooling medium to, for example 35° C. The cooling medium that has thus been heated again is applied, via the third duct sub-system 9, to the heat exchanger 6 in which the cooling medium is cooled to the temperature of 20° C. again. One or more temperature sensors 17 are provided in the X-ray detector in order to generate a signal 15 that is dependent on the temperature in the X-ray detector and is applied, via the lead 15, to the heat exchanger 6 for the purpose of temperature control.

[0029] FIG. 3 is a detailed representation of a dynamic X-ray detector 1. The X-ray detector 1 consists of an X-ray converter unit 11a, a sensor layer 11 and a glass layer 10 that is provided underneath the sensor unit 11. Underneath the sensor unit 11 there is provided a processing unit 12 which includes a plurality of amplifier units 13. The amplifier units 13 serve to amplify the image signals read out from individual image zones of the sensor unit 11 and produce heat. The amplifier units 13 are arranged in such a manner that they adjoin the cooling unit 14 and hence a continuous reduction of the temperature can take place, so that all amplifier units 13 can operate at the same low temperature level. This enables all image zones of the sensor unit 11 to be amplified under the same conditions, thus avoiding the formation of incorrect renditions of the overall image. The cooling unit 14 receives the cooling medium of a constant temperature of 20° C. via the first duct sub-system 7 which is not shown in FIG. 3. The cooling medium is transported away from the X-ray detector 1 via a second sub-duct 8 (not shown either). A further processing unit 16 serves for the further processing of the amplified image signals and for the supply to peripheral apparatus.

1. An X-ray examination apparatus which includes a supporting device (3), an X-ray detector (1) and an X-ray source (2), and

a system of ducts (7, 8, 9) which is coupled to a heat exchanger (6), is associated with the X-ray detector (1) and the X-ray source (2), and is intended to receive a cooling medium.

2. An X-ray examination apparatus as claimed in claim 1, characterized in that the cooling medium is arranged to be applied, via a first duct sub-system (7), to the X-ray detector (1) in order to keep the temperature constant and, after a first exchange of heat between the cooling medium and the X-ray detector (1), to the X-ray source (2), via a second duct sub-system (8), and to the heat exchanger (6) via a third duct sub-system (9).

3. An X-ray examination apparatus as claimed in claim 1, characterized in that the X-ray detector (1) includes image point sensors which are arranged in the form of a matrix, groups of image point sensors being associated with amplifier units (13) for amplifying image signals.

4. An X-ray examination apparatus as claimed in claim 1, characterized in that the cooling medium is applied to the X-ray detector at a constant temperature.

5. An X-ray examination apparatus as claimed in claim 1, characterized in that, after a first exchange of heat with the X-ray detector, the cooling medium can be applied to the X-ray source without temperature reduction or cooling.

6. An X-ray examination apparatus as claimed in claim 1, characterized in that the X-ray detector is provided with a temperature sensor (17) for producing a signal (15) that is dependent on temperature, the temperature signal (15) being applied to the heat exchanger (6) in order to control the temperature of the cooling medium.

7. An X-ray examination apparatus as claimed in claim 1, characterized in that the heat exchanger (6) is arranged outside the supporting device (3).

8. An X-ray detector which includes a sensor unit (11) which converts the X-rays into electrical signals, a processing unit (12) which adjoins the sensor unit (11) and includes a plurality of amplifier units (13) that are associated with a cooling unit (14) which contains a cooling medium that enables the temperature of all amplifier units (13) to be kept constant as well as the cooling of the X-ray converter unit (11a) provided in the sensor unit (11).

9. A method of cooling X-ray examination apparatus, in which a cooling medium is applied to an X-ray detector (1) and in which, after a first exchange of heat between the cooling medium and the X-ray detector (1), the heated cooling medium is applied to the X-ray source (2) for the purpose of cooling.

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